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PRESCRIBED BURNING DOES NOT REDUCE YIELD FROM OAK-PINE STANDS OF SOUTHERN NEW JERSEY

by

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INTRODUCTION

WHEN FIRE is prescribed as a silvicultural treatment, questions usually arise about the amount of damage the fire does by killing or wounding trees or by retarding growth. Some answers to these questions are now available for the oak-pine stands of southern New Jersey.

Data on mortality, basal wounding, and growth were collected during experiments with prescribed fires in the Pine Region of New Jersey. The studies were begun in 1936

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[1] STATIONED AT THE LEBANON EXPERIMENTAL FOREST, NEW LISBON, N. J., WHICH IS MAINTAINED BY THE NORTHEASTERN FOREST EXPERIMENT STATION IN COOPERATION WITH THE NEW JERSEY DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT, SECTION OF FORESTRY, PARKS, AND HISTORIC SITES.

and 1940. Records taken through 1946 show that the experimental fires did some damage, but it was slight and did not nullify the value of prescribed burning.

The advantages of prescribed burning have already been pointed out in previous publications.[2] Periodic use of light, winter fires appears to offer an effective and economical way to convert oak-pine forests to pine and to maintain subclimax pine stands. These fires prepare seedbeds favorable for the germination of pine seeds, but unfavorable for the establishment of oak seedlings. They also kill small hardwood seedlings and kill back larger hardwood reproduction. Thus the establishment of pine is favored. At the same time, the burning reduces the natural fuel and thus helps to protect the forests from hot and destructive wild fires.

In practice, carefully controlled fires are prescribed at intervals of 4 or 5 years in most oak-pine stands more than 15 years old. The use of these periodic burns should be discontinued sometime during the 5 years before the harvest cutting of the mature stand, preferably just before a good crop of pine seed is borne. After the reproduction has grown big enough to withstand prescribed burns, the periodic burning should be resumed. This stage will usually be reached 12 to 15 years after the harvest cutting.

The findings reported on in this paper substantiate previous reports. They indicate that the proper use of prescribed fires does not reduce the yield from oak-pine stands, and does not adversely affect the growth of the desirable crop trees in the burned stands.

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[2] LITTLE, S. THE EFFECTS OF FOREST FIRES ON THE STAND HISTORY OF NEW JERSEY'S PINE REGION. NORTHEAST. FOREST EXPT. STA. FOREST MANGT. PAPER 2. 43 PP., ILLUS. 1946.

LITTLE, S., ALLEN, J. P., AND MOORE, E. B. CONTROLLED BURNING AS A DUAL-PURPOSE TOOL OF FOREST MANAGEMENT IN NEW JERSEY'S PINE REGION. JOUR. FORESTRY 46: 810-819, ILLUS. 1948.

LITTLE, S., AND MOORE, E. B. CONTROLLED BURNING IN SOUTH JERSEY'S OAK-PINE STANDS. JOUR. FORESTRY 43: 499-506. ILLUS. 1945.

LITTLE, S. AND MOORE, E. B. THE ECOLOGICAL ROLE OF PRESCRIBED BURNS IN THE PINE-OAK FORESTS OF SOUTHERN NEW JERSEY. ECOLOGY 30: 223-233, ILLUS. 1949.

EXPERIMENTAL AREAS AND METHODS

1936 STUDY

THE FIRST EXPERIMENT, begun in 1936, was made on sixteen 5-acre plots. Fourteen of the plots were treated with prescribed burns, two plots at each of the following intervals: 1, 2, 3, 4, 5, 10, and 15 years. The other two plots were left unburned. All treated plots were first burned in March 1937.

Records on this experiment are available for the 10-year period 1936-46. Measurements of all trees 0.6 inch d.b.h. (diameter breast high) or larger have been made on a 0.5-acre strip through each plot, or on 1.0 acre per treatment. The first records were tallies by 1/20-acre subplots, species, and 1-inch d.b.h. classes. However, in 1938 these trees were numbered and records by individual trees were started. Since then, d.b.h. measurements of the numbered trees have been recorded to the nearest tenth of an inch.

The 1936 experiment was in a mixed oak-pine stand. The oaks were chiefly black and white oaks, but some chestnut oaks and post oaks were also present. Most of the pines were either pitch or shortleaf. However, on some of the plots Virginia pines or blackjack oaks were also found.

The stand selected for this first study was not typical of most oak-pine stands in southern New Jersey. It had an overstory of large oaks and pines and a light understory of both, a condition not usually found. The oaks were decadent as a result of their sprout origin, age, and past damage from uncontrolled fires. They fell into four age classes dating from wild fires in 1870, 1879, 1895, and 1904. In

addition, many of the oaks had been partly defoliated by grasshoppers shortly before the study began and were defoliated again 1 year later.

1940 STUDY

The second study, begun in 1940, was in a typical oak-pine stand. This was composed of scattered large pines and a fairly dense understory of sprout oaks 17 years old. Species composition was similar to that in the first experimental area.

The 1940 study was made on fourteen 1-acre plots and was designed to determine the effect of the annual use of prescribed fires. As in the first experiment, two plots were left unburned. Of the other 12 plots, two were scheduled for each of six treatments: one, two, three, four, five, and six annual burns. The last fire on all burned plots was made in the winter of 1945-46.

Some of the overwood on all plots was cut prior to prescribed burning. On all plots the pines were reduced to 15 seed trees per acre to provide uniformity of seed source. On half of the plots the hardwoods were thinned from approximately 1,200 trees per acre to 400. The purpose of the thinning was to determine its effect on the damage in prescribe-burned stands and on the establishment of pine reproduction. Slash from the cutting of both pines and oaks was piled and burned--off the plots.

Records on the 1940 experiment were limited to the inner 0.4 acre of each plot. There tallies of trees 0.6 inch d.b.h. and larger were made on 0.1-acre subplots, by species and 1-inch d.b.h. classes.

Although tallies were made prior to cutting, those used as a basis for data in this paper are the tallies made after the cutting and in the fall before the first prescribed burning of a plot. Hence the period covered ranges by treatments from 1 to 6 years.

At the end of the 1946 growing season, the plots in both experimental areas were retallied. At that time any tree that appeared to have been injured was carefully examined. Enough outer bark was removed from the tree to permit measurements of the length and width of the fire wound or scar, if one was found. These measurements were made to the nearest hundredth of a foot.

MORTALITY

PINES

NONE OF THE pine seed trees left in the 1940 experiment had died by 1946.

On the plots of the 1936 experiment, where pines of different sizes were left, prescribed burning did not affect the mortality[3] of pines 1.6 inches d.b.h. and larger. Under all frequencies of burning fewer of these pines died than on the unburned plots (table 1).

Among the smaller trees, mortality was increased by prescribed burning. In the 1-inch class (0.6 to 1.5 inches) more trees usually died on the burned areas than on the unburned controls--especially on areas treated at 2- or 3-year

[3] AS USED IN THIS PAPER, 'MORTALITY,' 'DYING,' AND 'KILLING' REFER ONLY TO THE DEATH OF THE STEM, REGARDLESS OF SPROUTS PRODUCED LATER.

Table 1.--Ten-year mortality of pines on areas periodically treated with prescribed burns

Interval between burns (years)	Burns used, 1936-46	Trees present[1]		Mortality (1936-46) of trees--		
		0.6-1.5 inches	1.6 inches or larger	0.6-1.5 inches	1.6 inches or larger	All sizes
	Number	Number	Number	Percent	Percent	Percent
1	10	30	37	7	0	3
2	5	21	32	24	9	15
3	4	53	55	26	4	15
4	3	42	56	5	9	7
5	2	15	34	0	3	2
10 or 15	1	25	63	8	6	7
All treatments	--	186	277	13	5	9
Unburned plots	0	26	41	4	12	9

[1] On the portions of plots where records were taken. Both the numbers of trees and the diameters are those of 1936. Pines include pitch pine, shortleaf pine, and some Virginia pines.

Table 2.--Mortality of trees growing into the 1-inch d.b.h. class on periodically burned areas

Interval between burns (years)	Burns used, 1936-46	Trees present[1]		Mortality by 1946	
		Pines	Oaks	Pines	Oaks
	Number	Number	Number	Percent	Percent
1	10	19	3	16	100
2	5	17	3	0	67
3	4	21	16	10	62
4	3	16	11	6	27
5	2	16	8	12	38
10 or 15	1	46	18	2	11
All treatments	--	135	59	7	39
Unburned plots	0	37	4	0	0

[1] On the portions of the plots where records were taken. The number of trees includes all trees growing to 0.6 inch d.b.h. between 1936 and 1946. Pines do not include Virginia pine.

intervals. The average increase in mortality was 9 percent (table 1). This was similar to the mortality among the pines that grew into the 1-inch class during the 10-year period (table 2). The smallest pines (less than 4 feet tall) were most susceptible to damage. The prescribed fires killed 60 to 100 percent of the pines 1.6 to 3.5 feet tall during the first 5 years. Shortleaf and pitch pine were found to be about equally resistant to killing by prescribed fires.

OAKS

Oaks suffered a greater mortality from prescribed burning than pines. The difference was most noticeable among trees growing into the 1-inch class during the period of the 1936 experiment. The more burns, the greater the difference. On the unburned areas, the mortality rate was the same for oaks and pines. On areas burned once, mortality of oaks was 9 percent greater than mortality of pines; on areas burned 10 times it was 84 percent greater (table 2).

Oaks in the 1-inch class also had a greater mortality from prescribed burning than pines of similar size. In unthinned stands of the 1940 experiment the death rate of 1-inch oaks was increased 3 percent annually by burning.[4]

Among oaks larger than 1 inch d.b.h. there was little increase in mortality except where the fires were hotter than usual. In stands more than 15 years old most of the mortality was among small, overtopped trees. The different oak species were about equally susceptible to killing.

In stands like that of the 1940 study the death rate of oaks is usually high even without fires, although it varies from year to year. The naturally high death rate was greatly reduced by thinning the original stand of 1,200 oaks to 400 per acre. There was almost no mortality of oaks in

[4] DATA ARE NOT PRESENTED ON THE MORTALITY OF OAKS IN THE 1936 EXPERIMENT BECAUSE OF THEIR GREAT VARIANCE AND THE ABNORMALLY HIGH NATURAL MORTALITY. THERE 16 PERCENT OF THE OAKS 5 INCHES AND LARGER ON UNBURNED PLOTS DIED DURING THE 10 YEARS.

the thinned stands; burning did not increase it (table 3).

However, neither the naturally high death rate of small oaks in unthinned stands nor increased mortality from prescribed burning can be considered an important loss, because on the average acre of the 1940 study area there were (in 1946) 330 oaks 3 inches or more in diameter in addition to the pines.

Table 3.—Annual mortality of oaks on areas treated with annual prescribed burns[1]

THINNED STANDS

Number of burns	Number of trees--			Annual mortality of trees--			
	1 inch	2 - 4 inches	5 inches or more	1 inch	2 - 4 inches	5 inches or more	All sizes
	Number	Number	Number	Percent	Percent	Percent	Percent
6	19	126	12	2	0.0	0	0.2
5	24	121	11	2	0.2	0	0.4
4	16	126	17	0	0.0	0	0.0
3	5	148	6	0	0.0	0	0.0
2	24	108	19	2	0.0	0	0.3
1	3	138	20	0	0.0	0	0.0
All treatments	91	767	85	1	0.0	0	0.2
Unburned plots	12	120	29	0	0.4	0	0.3
UNTHINNED STANDS							
6	265	353	14	8	0.8	0	4
5	257	243	9	12	4.0	0	8
4	229	166	18	7	0.3	1	4
3	186	243	22	7	1.0	0	4
2	176	226	36	8	1.0	0	4
1	107	190	43	13	2.0	0	5
All treatments	1,220	1,421	142	9	1.4	0.2	5
Unburned plots	246	311	3	6	0.5	0	3

[1] The mortality rate here is based on tallies before prescribed burns but after thinning, and on tallies at the end of the 1946 growing season. Thus, for unburned plots and for those treated with 6 burns the basis is 6 years, or tallies made at the end of the 1940 and 1946 growing seasons; whereas for areas burned only once the basis is only 1 year, or tallies made at the end of the 1945 and 1946 growing seasons. Hence, for comparative purposes, the data are presented on an annual basis. The d.b.h. indicated is that of the initial tally.

BASAL WOUNDING

PINES

THE PRESCRIBED FIRES used in the studies caused little basal wounding of the pines. The seed trees left on the 1940 experimental area suffered no basal wounding at all. In the 1936 experimental area, open wounds were found only on trees that were 1 inch or less in diameter at the time the burning treatments were begun (table 4).

Moreover, the wounds found on the pine trees were generally small. Eighty percent were 1 foot or less in length and 1/10 foot or less in width. In fact, 30 percent were considered healed (table 5).

Table 4.--Surviving pines with basal wounds on periodically burned areas[1]

Burns used (number)	Ingrowth since 1936		Trees 0.6-2.5 inches		Trees 2.6 inches and larger	
	All wounds	Open wounds	All wounds	Open wounds	All wounds	Open wounds
	Percent	Percent	Percent	Percent	Percent	Percent
10	19	19	7	3	0	0
5	12	12	6	6	0	0
4	16	8	8	6	0	0
3	0	0	2	2	0	0
2	19	6	0	0	0	0
1	0	0	0	0	0	0
All treatments	9	6	4	3	0	0

[1] Diameters are those of 1946, except that ingrowth includes all stems reaching 0.6 inch in diameter since 1936, regardless of present diameter.

OAKS

The oaks proved much more susceptible to basal wounding than the pines. On the burned plots of the 1936 study, 19 percent of the surviving oaks (that had been larger than 0.5 inch d.b.h. in 1936) had basal fire wounds; but only

Table 5.--Size of basal wounds caused by prescribed burns

(In percent of injured trees)[1]

Size of wound or scar (feet)	1936 study of periodic burns		1940 study of annual burns	
	Pines	Oaks	Oaks in unthinned stands	Oaks in thinned stands
	Percent	Percent	Percent	Percent
Length:				
0.01-0.25	15	12	11	12
0.26-0.50	20	18	26	40
0.51-1.00	45	31	28	30
1.01 or more	20	39	35	18
(Maximum: feet)	(1.4)	(5.7)	(9.0)	(3.5)
Width:				
Healed	30	33	25	57
0.01-0.10	50	20	40	32
0.11-0.25	20	22	29	10
0.26 or more	0	25	6	1
(Maximum: feet)	(0.2)	(1.8)	(0.9)	(0.3)

[1] Based on all trees injured by all burning treatments of the study indicated. Ingrowth is included. Size of wounds is as of 1946.

2 percent of the pines had wounds. Furthermore, 15 percent of the oaks 3 inches or larger were wounded, but none of the pines of that size were wounded.

The greater susceptibility of the oaks to basal wounding is also shown by the greater size of the wounds they bore. In the 1936 study, the percentage of injured

oaks that bore wounds greater than 1 foot long or 1/10 foot wide was about twice the percentage of injured pines (table 5).

FACTORS THAT AFFECT WOUNDING

Both the size of the fire injuries and the proportion of surviving trees that bear them are affected by several factors: size of tree, thinning, form of tree, number of burns, and intensity of fire. The effect of these factors is more readily apparent on the oaks than on the less-susceptible pines, but the same factors affect both.

Size of tree

The greater the size of the tree, the smaller the danger of basal wounding. This held true in both studies, and, in the 1940 study, for both thinned and unthinned oaks (table 6).

Table 6.--Basal wounding[1] of surviving oaks in relation to size of tree

D.b.h. (inches)	1936 plots	1940 unthinned plots	1940 thinned plots
	Percent	Percent	Percent
1	38	32	22
2-4	29	17	10
5-8	14	4	5
9 or more	8	0	0
All sizes	19	20	9

[1] On treated plots. Diameters indicated are those of 1946. Ingrowth is included.

Thinning

Thinning tended to reduce both the size and the number of basal injuries on oak trees (tables 5 and 6). This was because many of the trees that were highly susceptible to injury had been removed. The thinnings were chiefly from below; they reduced the number of highly susceptible 1-inch oaks from 508 to 38 per acre. Thus the kind of thinning alone accounts for much of the difference in the amount of fire injury (table 6).

Form of tree

Any lean or crook in the lower bole of a tree--even the curved base of a sprout--renders a stem more susceptible to injury, because part of the stem may be directly over the flames of a fire. The unthinned stands contained many over-

Table 7.--Percentage[1] of surviving oaks wounded, by condition of wound and number of prescribed burns

Area and condition of wound	Treatment used							
	1 burn	2 burns	3 burns	4 burns	5 burns	6 burns	10 burns	All
1936 study								
All wounds	5	36*	20	37*	9	--	20	19
Open wounds	3	26	11	28	4	--	14	13
Open wounds more than 3 inches wide[2]	0.5	15	1	13	1	--	2	5
1940 unthinned plots								
All wounds	5	7	10	19	56*	28	--	20
Open wounds	4	4	8	13	44	21	--	15
Open wounds more than 3 inches wide[2]	1	0.2	1	0	6	1	--	1
1940 thinned plots								
All wounds	2	3	2	16	15**	18	--	9
Open wounds	2	1	1	8	5	7	--	4
Open wounds more than 3 inches wide[2]	0	0	0	0	1	0	--	0.1

[1] Includes ingrowth.

[2] At widest part in 1946.

* Greater damage than in other treatments because of greater intensity of fires used in 1940 or 1942.

** Burned at a different time in 1942 than the same treatment in unthinned stand, and hence damage not outstanding.

topped, badly leaning stems, especially in the 1-inch class. Of course the badly leaning stems were the most susceptible, and even the light fires prescribed may cause long wounds on them. A wound 9 feet long was measured on one such tree in the 1940 study area (table 5). Consequently, removal of such poorly formed trees in the thinning reduced the proportion of surviving trees that were damaged.

Number of burns

The amount of injury tends to increase with the number of prescribed burns. This is shown best in the unthinned stands of the 1940 study, where the number of surviving oaks that bore wounds ranged from 5 percent after one burn to 28 percent after six burns (table 7). The trend is less well defined in the 1936 experiment and the thinned plots of the 1940 experiment.

Intensity of fire

The intensity of the fires varies somewhat, and hotter-than-usual fires may cause an exceptional amount of injury. This happened in the 1936 study on the plots burned two and four times, and in the 1940 study on the unthinned plots burned five times. The damage from these burns is attributed to the greater intensity of the fires used on those plots in 1940 and 1942.

However, the exceptional damage caused by the fires used in 1940 and 1942 was limited to plots that either had not been prescribe-burned previously or had been burned only once, 3 or 5 years earlier. Of course these plots had more fuel, and hence hotter fires, than the areas burned previously or at shorter intervals.

A good example of the effect of fire intensity is the difference in damage caused by five and six prescribed fires in the unthinned stands of the 1940 study. There 56 percent of the surviving oaks were wounded by five burns, but only 28 percent by six burns. Yet all burns between 1942 and 1946

were made in both areas on the same days. The difference in damage is attributed solely to the lower fire intensity in 1942 on the area burned six times, for this had been burned in 1941 and hence had less fuel than the area that was burned for the first time.

It is apparent that if basal wounding is to be held to a minimum, the prescribed fires should be of low intensity. Greater skill and better judgment are needed in using fire on areas not previously prescribe-burned or burned at longer intervals.

Even within a single burn, the intensity of a prescribed fire may vary and produce local differences in damage. The variations in fire intensity are due chiefly to local differences in the amount of fuel and its moisture content. A snag or broken top that has fallen at the base of a tree may greatly increase the intensity or duration of the fire. On one of the 1936 plots a 14-inch oak was apparently wounded this way; it had a wound 1.8 feet wide.

SIZE AND NUMBER OF WOUNDS

Prescribed burns usually do not produce many large basal wounds. Of the surviving oaks on burned areas of the 1936 study, only 7 percent had basal wounds more than 1 foot long in 1946, and only 3 percent had wounds more than 2 feet long. No injuries more than 1 foot long had developed on the 1940 plots where the stand had been thinned, then burned one to three times.

However, length of wound is probably less important than width. Since wounds heal from the side, width is probably a better criterion of the length of time a wound provides an avenue for the entrance of wood-rotting fungi.

Wounds more than 3 inches wide take several years to heal; so they might be considered of special importance. Such wounds were found mostly on the plots burned in 1940 or 1942 (table 7). There as many as 15 percent of the oaks had wounds more than 3 inches wide. On the other plots no more than 1 percent of the oaks were similarly damaged.

IMPORTANCE OF BASAL INJURIES

The basal wounding caused by the prescribed burns was not of great importance. The most damaging treatment caused open wounds on 44 percent of the surviving oaks, but even there 435 oaks per acre did not have open wounds in 1946.

Furthermore, there is no indication that the prescribed use of fire will cause enough wounds to reduce the yield or value of the products that can be harvested from the hardwoods of the Pine Region. These hardwoods are of poor quality, and they are utilized only for fuel wood or other low-value products.

GROWTH

THE PRESCRIBED BURNS studied apparently have not retarded tree growth. The average diameter growth of all surviving trees on areas burned in the 1936 study was 0.6 inch during the 8-year period 1938-46. The same rate of growth was found on the unburned plots (table 8). Similar results were obtained in the 1940 study (table 9).

These results are supported by Jemison's findings in the southern Appalachians.[5] He found that the diameter growth of white oak, scarlet oak, and yellow-poplar was not usually reduced after severe wounding by a spring or fall fire. The diameter growth of some scarlet oaks was reduced

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[5] JEMISON, G. M. THE EFFECT OF BASAL WOUNDING BY FOREST FIRES ON THE DIAMETER GROWTH OF SOME SOUTHERN APPALACHIAN HARDWOODS. DUKE UNIV. SCHOOL FORESTRY BUL. 9. 63 PP., ILLUS. 1944.

Table 8.--Average growth of surviving trees during 8 years (1938-46) on periodically burned areas[1]

Burns used, 1936-46 (number)	All trees of all species		200 fastest growing trees per acre	
	Basal area	D.b.h.	Basal area	D.b.h.
	Square feet	Inches	Square feet	Inches
10	0.037	0.6	0.047	0.7
5	.047	.7	.049	.7
4	.033	.6	.046	.7
3	.030	.5	.041	.7
2	.041	.6	.045	.7
1	.038	.6	.046	.7
All treatments	0.037	0.6	0.046	0.7
Unburned plots	0.038	0.6	0.050	0.7

[1] Of the 1936 study.

somewhat, but he attributed this to injury of the crown, not to wounding of the stem. In the New Jersey studies, the prescribed fires caused no injury to the crowns of either oaks or pines in the overwood; so the lack of any effect upon growth appears to be logical.

Nor did thinning the oak overstory (on the 1940 plots) affect the growth of crop trees (table 9). This is in agreement with the findings of earlier studies. Moore[6] stated that thinnings in the sprout oaks of the Pine Region are not justified because there is little response. A thinning experiment[7] in a stand similar to that used in the 1940 prescribed-burning study showed that the average diameter growth of crop trees during 5 years ranged only from

[6] MOORE, E. B. FOREST MANAGEMENT IN NEW JERSEY. N. J. DEPT. CONSERV. AND ECON. DEVLPMT. 55 PP., ILLUS. 1939.

[7] LITTLE, S. PROGRESS REPORT ON THINNING PLOTS IN A SOUTH JERSEY OAK-PINE STAND. (UNPUBLISHED MANUSCRIPT, NORTHEAST. FOREST EXPT. STA.) 1942.

Table 9.--Average annual growth of oak crop trees in relation to thinning and prescribed burning[1]

Number of burns	Basal area growth		Diameter growth	
	Thinned plots	Unthinned plots	Thinned plots	Unthinned plots
	Square feet	Square feet	Inches	Inches
6	0.0037	0.0032	0.1	0.1
5	.0039	.0033	.1	.1
4	.0049	.0031	.1	.1
3	.0054	.0053	.1	.1
2	.0051	.0042	.1	.1
1	.0033	.0068	.1	.1
All treatments	0.0044	0.0043	0.1	0.1
Unburned plots	0.0049[2]	0.0042	0.1	0.1

[1] Data are from 1940 study. Basis on thinned plots is all oaks living in 1946; on unthinned plots, 40 largest oaks on each 0.1-acre subplot or 160 per plot (or at the rate of 400 per acre). Tallies used were made just before a burning treatment was started and in 1946.

[2] 0.0028 square feet for the 4 years prior to thinning.

0.6 inch on heavily thinned plots to 0.5 inch on unthinned plots.

Evidently the growth of the oak-pine stands is rather slow. The crop trees grow only about 1 inch in diameter in 10 years. In volume, the annual growth is only 0.2 to 0.3 cord per acre, according to Moore.

However, stands of pine seedlings developing on similar sites grow faster than the oak-pine stands, and their growth might be affected more by thinning or prescribed burning. Many of these pine seedlings grow 1 inch in diameter in 3 years, and well-stocked stands have an annual growth rate of nearly 1 cord per acre. (One unthinned stand of old-field pines 45 years old had a mean annual growth of 0.9 cord per acre.) Thinning such stands between the ages of 20 and 40 years probably would increase or maintain the growth rate of dominant trees. But whether prescribed burning would also affect the growth of such pine stands remains to be determined.

Potentially, the over-all beneficial effect of prescribed burning on growth in the Pine Region is great. Some areas there have not produced any merchantable timber for many years because of losses in severe, wild fires. Other areas have yielded little, and even the better oak-pine stands are growing at only one-third the rate of seedling pine stands. Prescribed burning not only helps to prevent losses from wild fires; it also favors the establishment of seedling pines. Treated properly, these seedling pines will develop into fast-growing, valuable stands. Thus, used with some other simple management measures, prescribed burning may increase at least tenfold the present rate of growth in the Pine Region.

SUMMARY

MORTALITY OF PITCH and shortleaf pines caused by prescribed burning was limited to stems 1 inch or less in diameter (breast high). Of trees growing into the 1-inch class during the 10 years, 7 percent of the pines died on the treated areas, compared to 39 percent of the oaks. The mortality rate of oaks in this size class increased with the number of burns, from 11 percent on the areas burned once to 100 percent on the plots burned 10 times. Some increase in the mortality rate of larger oaks also resulted from the burns, but only in unthinned stands. There it was concentrated in the small, overtopped oaks and was not of economic importance.

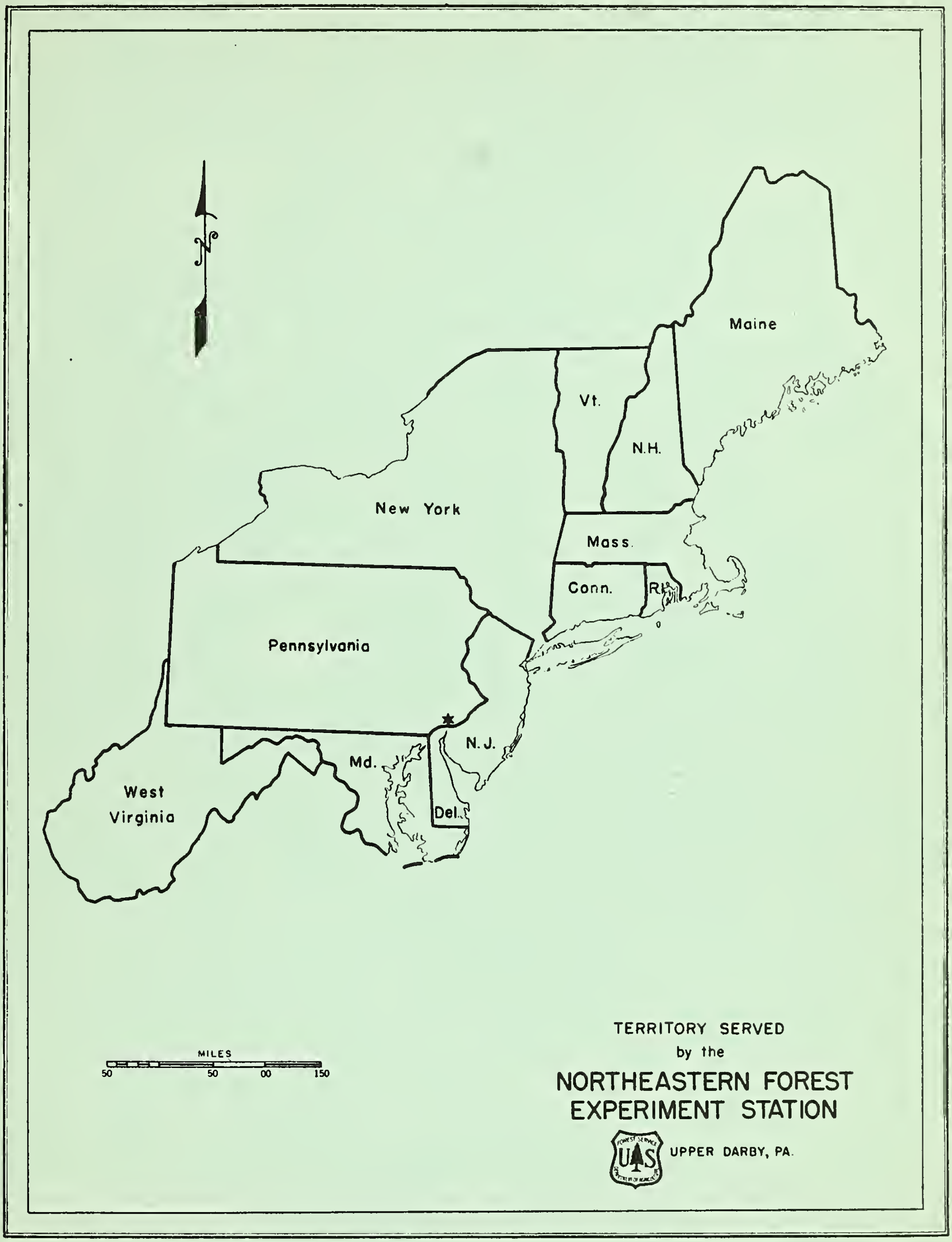
Prescribed burns did not cause any basal wounds on pines larger than 2 inches in diameter, nor any open wounds on pines larger than 1 inch diameter at the start of the burning treatments. The injuries on the pines were usually smaller and much less numerous than on the oaks. Furthermore, much larger oaks than pines were injured. Differences in the amount of wounding were due partly to the number of burns, but even more to the intensity of individual fires.

Thinned stands suffered far less basal wounding than unthinned stands, because the thinnings had removed a high proportion of the trees susceptible to injury because of their small size or poor form. However, neither thinnings nor prescribed burning affected appreciably the growth rate of crop trees in the oak-pine stands studied.

The relatively small amount of basal wounding caused by properly used fires is likewise not important, especially in view of the fact that the hardwoods of the New Jersey Pine Region are usually utilized only for fuel wood and other low-value products.

The proper use of prescribed burns does not cause enough damage to reduce the economic yield of treated oak-pine stands.

AGRICULTURE - FOREST SERVICE - UPPER DARBY



N
Maine
Vt.
N.H.
New York
Mass.
Conn.
R.I.
Pennsylvania
N.J.
Md.
Del.
West
Virginia
MILES
50
50
100
150
TERRITORY SERVED
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